Amendment(s) to the Claim(s):

The listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (currently amended) An apparatus for generating a quantum state of a two-qubit system including two qubits, each qubit being represented by <u>a detector probability, where the probability is based upon N samples of a system in which</u> a particle which invariably travels through one of two paths, the apparatus comprising:

a first beam splitter configured to receive a first particle of two particles having no correlation with each other, and to output the first particle into two paths in a superposition; and

an interferometer configured to implement an interaction-free measurement, <u>wherein an interaction-free measurement is a probability measurement method defined as:</u>

<u>the condition when, after the N samples of the system containing the two particles, the probability of detection of a particle after N samples by a detector is about</u> $P_C \approx \cos^2\theta\sin^2\theta$, <u>wherein N is defined as N=1/(1-P_B)=1/(1-$\cos^4\theta$), wherein θ is a characteristic of the first beam splitter , wherein</u> $P_B \approx \cos^4\theta$, <u>and wherein</u> the interferometer <u>is configured to</u> receiving a second particle of the two particles and <u>the</u> output of the first beam splitter and generatesing a Bell state with asymptotic probability 1.

2. (previously presented) An apparatus according to Claim 1, wherein the interferometer includes a cavity and second beam splitters sectioning the cavity into two chambers,

2

wherein the two particles are input into different chambers of the cavity, the first particle absorbing the second particle if the first particle and the second particle come near enough to each other, and

wherein the second particle successively hits the second beam splitters so that the transmitted wave component in the wave function of the second particle travels back and forth between the two chambers.

3. (previously presented)   An apparatus according to Claim 2, wherein the particle transmittance of the second beam splitters is set to a predetermined value or less so that the probability amplitude of the state in which the second particle is absorbed by the first particle by entering the chamber containing the first particle when the second particle hits each of the beam splitter is set small, and

wherein the first and the second particles repeatedly approach each other with an extremely small probability amplitude so that the first particle absorbs the second particle with probability close to zero,

whereby the second particle is put into different chambers depending on whether the first particle is input to the cavity.

4. (previously presented)   An apparatus according to Claim 3, wherein the first beam splitter outputs the first particle to one of the chambers while the first particle is in a quantum superposition of present and absent states, so that the first particle and the second particle are put into the Bell state with asymptotic probability 1.

5. (previously presented)   An apparatus according to Claim 3, wherein the first beam splitter implements a Hadamard transformation and thereby inputs the first particle to one of the

chambers while the first particle is in a quantum superposition of present and absent states, so that the Bell state is generated with asymptotic probability 1 if the number of times the second particle hits the beam splitters in the interferometer is large.

6. (original)   An apparatus according to claim 3, wherein the two particles are photons and the Bell state is generated using an auxiliary system including a three-level atom by regarding a ground state in which the atom can absorb the photons as a state in which the second particle is absorbed by the first particle and a first excited state in which the atom cannot absorb the photons as a state in which the second particle is not absorbed by the first particle.

7. (original)   An apparatus according to claim 6, wherein a transition of the atom between the ground state and the first excited state is implemented by Rabi oscillation, and the energy of the two photons is the same as the difference in energy level between the ground state and a second excited state of the atom.

8. (original)   An apparatus according to claim 3, wherein the two particles are a positron and an electron and the Bell state is generated by regarding a state in which a photon is generated by pair annihilation of the positron and the electron as the state in which the second particle is absorbed by the first particle, the pair annihilation occurring if the positron and the electron come near enough to each other.

9. (original)   An apparatus according to claim 3, wherein the two particles are a hole in a semiconductor and a conducting electron and the Bell state is generated by regarding a state in which a photon is generated by pair annihilation of the hole and the conducting electron as

4

the state in which the second particle is absorbed by the first particle, the pair annihilation

occurring if the hole and the conducting electron come near enough to each other.

Claims 10-16 (previously canceled)